

from **the Shoe**





Dear Friends of Biology,

It is our pleasure to present to you our annual newsletter, *from the shoe*. Life here in Shoemaker Hall continues to be exciting and rewarding. We have been working hard this past year on bringing the best educational experiences to our students and developing a leading department engaging in a nationally and internationally recognized life science research. We have also shared the challenge of continuing our work in the face of the COVID-19 pandemic. This world-wide challenge reminds us that we need our students now more than ever. We need them trained to confront our future challenges of emerging diseases and global environmental changes.

This year we have launched new courses, including a major's course in Human Anatomy, in which students learn anatomy from prosected human specimens, 3-D images from CT scans and fMRI, and a synthetic cadaver. We also pioneered a new course in advanced microscopy entitled *Illuminating the Invisible: Microscopes*, in which students learned how to acquire images and analyze the behavior of fluorescently-labeled molecules within cells using our laser-scanning confocal microscope. Our students also continued to explore and learn about living systems in exotic environments in our Study Abroad and Study USA courses. We strive to provide learning experiences for our students that are deep, varied, and life-changing.

Critical to a comprehensive education in the life sciences is exposure to cutting-edge research. This past year, faculty within the Department of Biology have received more than \$1.9 million in new research funding coming from NASA, the National Science Foundation, and the National Institutes of Health. Our faculty are training our next scientists to solve some of the biggest challenges facing our country and our world. Notable this year is our new Center for Biodiversity and Conservation Research, which is leading research initiatives to identify new ways to conserve species and ecosystems from ongoing threats, including global change. We are working to be an agent of positive change for you and future generations.

In the face of the pandemic, we temporarily moved all our courses to remote instruction, allowing the students to avoid large classrooms and labs and to learn in the safety of their own homes or apartments. Our faculty made this turn around in course format in one week, a fantastic feat that makes me so proud of their hard work and their dedication to our students. We also wish you to be proud of our accomplishments, and we invite you to be part of our efforts. Please keep in touch with us and let us know how you have been and what you have been doing. You can email us at biology@olemiss.edu. We very much look forward to hearing from you.

Hotty Toddy,

Gregg Roman
PROFESSOR AND CHAIR

In the Fall of 2019 the Biology Department celebrated 26 years of teaching and research excellence as Dr. Lucile McCook retired.

A longtime participant in the Introductory Biology (BISC 160) series and the founding director of the Biology



Bootcamp program, she will be familiar to many biology alumni. Dr. McCook still walks the halls of Shoemaker as she continues to manage the Pullen Herbarium and act as an academic advisor (see article on p. 5).



The Biology Department also welcomed Assistant Professor Yongjian Qiu. Dr. Qiu's research

on the genetic and physiological responses of plants to temperature changes is increasingly relevant in both academic and agricultural circles. He has recently completed postdoctoral fellowships at Duke University and the University of California Riverside. 🌱

Amanda Gerard

BA BIOLOGICAL SCIENCES
AND PSYCHOLOGY '15



W

hy did you study biology?

My interest in biology developed in high school science classes. I was fascinated by many aspects of the field, but the AP biology unit about genetics particularly interested

me. I was not set on a specific career path when I started my undergraduate coursework, but I knew biology interested me and I explored it further. I discovered my current field of genetic counseling through online research and some biology courses.

Highlights of your undergraduate experience?

My courses helped determine my interests and what I wanted from my future career. The variety of courses available through the biology department allowed me to learn about many different specialties in the field. Once I decided on genetic counseling as a career, I took prerequisite courses for graduate school and participated in activities to strengthen my applications. I was also a psychology major, a member of the Sally McDonnell Barksdale Honors College, a member of the Ole Miss Band, and a frequent visitor of Big Bad Breakfast.

Discuss your path since graduation and current career goals.

I applied to genetic counseling programs during the fall of my senior year. Shortly after graduating, I started a master's degree program in genetic counseling at the University of Texas MD Anderson Cancer Center UTHHealth Graduate School of Biomedical Sciences. After receiving a master's degree two years later, I accepted a position as a genetic counselor at Baylor College of Medicine in Houston, Texas. I primarily work with pediatric patients in the genetics clinic at Texas

Children's Hospital. I see patients, contribute to research in the genetics field, and train new genetic counselors as a supervisor for the Baylor College of Medicine Genetic Counseling Program. My job is immensely enjoyable and rewarding, and I hope to continue contributing to this unique and growing field of science in the future.

Advice for biology majors?

Make the most of your time as an undergraduate to explore your interests! The department has a diverse offering of biology courses, and I enjoyed taking classes exploring different aspects of the field. I appreciated having an opportunity to learn about other topics in biology that interested me before progressing to more specialized coursework in graduate school.

I was also a psychology major, a member of the Sally McDonnell Barksdale Honors College, a member of the Ole Miss Band, and a frequent visitor of Big Bad Breakfast.

Find opportunities to gain exposure in areas of interest outside the traditional classroom setting. I shadowed genetic counselors prior to applying to graduate programs—which strengthened my applications and helped me feel confident that this was the right field for me. Many professionals in biology-related settings are happy to welcome visitors or to answer questions, and the biology department faculty and alumni provide great connections to help set up opportunities. 🌱

Graduate student research highlight

JP Lawrence, a recent graduate of the PhD program in biology at the University of Mississippi, made international headlines when the results of his UM-based graduate research were published in the *Proceedings of the National Academy of Sciences*.

The work—highlighted in popular press outlets including the *New York Times*—focused on a detailed exploration of a species of South American poison frog that exhibits wild variation in the bright colors (a favorite of photographers and wildlife calendars). It turns out, though the bright color is known to be a warning to potential predators that these frogs are decidedly un-tasty, the intensity of the color directly impacts how and whether predators attack these frogs. JP, working with Professor Brice Noonan, demonstrated that the way predators interact with their prey may have unexpected consequences, allowing for the origin of new, brightly-colored forms. 🌍

Dr. Lawrence works at Michigan State University and continues his work on poison frogs.



Undergraduate, Darius (DJ) Amos at microscope.

Undergraduate Research Profile

A

n underlying contributor to many forms of drug addiction are genetic variants responsible for high levels of “novelty-seeking” behavior. This personality trait is associated with dangerous and compulsive behavior, including using drugs of abuse. Identifying the genetic basis for differences in novelty-seeking will give us the necessary insight to understand the underlying neurobiology and may provide us with fresh ideas into why some people are likely to abuse drugs and are also more likely to relapse.

In the lab, DJ Amos works with different species of *Drosophila* (fruit flies) that differ widely in their novelty-seeking behavior. He has generated a novel genetic mapping population that he is using to identify the genetic variants responsible for differences in this behavioral trait. Amos plans to sequence the genomes of his population using state-of-the-art technology to identify the genes responsible for the differences in this behavior and shed light on the genetic causes for differences in novelty-seeking behavior. Amos presented his findings to the Mississippi Academy of Sciences this past Spring. 🌍

Darius (DJ) Amos is pursuing his B.S. in Biology and is actively participating in research yielding important insights into the drug addiction crises in the US.



Shade Smith in a Chiricahua Mountains cave during Jason Hoeksema and Peter Zee's Sky Island Biodiversity (BISC 380) course, taught each summer.

Photo by Jason Hoeksema

Study USA & Study Abroad

In Summer 2019, Professors Jason Hoeksema and Peter Zee along with Dr. J. R. Rigby from the US Geological Survey led a course on Sky Island Biodiversity for a group of 12 students (mostly biology majors) in southeastern Arizona.

Through daily field trips to diverse habitats ranging from Sonoran desert to mountain coniferous and oak forests (isolated like islands in a sea of desert), students learned about how geology, evolution, and ecology interact to shape the Earth's biodiversity. They visited the renowned Arizona-Sonora Desert Museum in Tucson, hiked among hoodoos in the Chiricahua National Monument, and explored caves in the Chiricahua Mountains. They chased beautiful birds such as the Elegant Trogon through mountain canyons; stalked scorpions, tarantulas, horned lizards, and rattlesnakes in the desert; and learned to identify diverse species of trees.

Their stay at the American Museum of Natural History's Southwestern Research Station provided interaction with scientists studying all aspects of biodiversity, and the students' independent research projects helped them to synthesize and apply what they learned. 🌐



COLLECTIONS

The Pullen Herbarium

An herbarium is a museum collection of plants and the information from where and when they were collected. This collection is used in teaching and in research to document changes in plant distribution through time.

The Department of Biology's Pullen Herbarium—located in Shoemaker Hall and curated by Dr. Lucile McCook—is named after the first curator, Dr. Thomas M. Pullen, and now consists of 80,000+ plant specimens. These specimens consist of dried, pressed plants attached to big sheets of high-quality paper, so they can be stacked in folders and organized by scientific name. While a majority of the specimens are from Mississippi and the southeastern US, the herbarium includes collections from all over the world from the late 1800s to the present.

National Science Foundation grants support the imaging and digitization of the Pullen Herbarium, so that all the collections are available and searchable on a community-based web portal: Southeast Regional Network of Expertise & Collections, <http://serneportal.org/portal/index.php>. Plants can be searched—115 herbaria at once—by scientific name, common name, plant family, geographic area, and more.

Recently, fungal collections of Dr. Pat Miller are being protected and curated in the Pullen Herbarium. The ~300 collections and beautiful photographs of the mushroom fruiting bodies are on display at the Mycology Collections Portal, <https://mycoportal.org/portal/collections/index.php>. 🌐

New Human Anatomy course utilizes synthetic cadaver

After much planning and preparation, a new course for biology majors, Bisc 310, Human Anatomy, was created. This was first offered in Spring 2019, and students got to meet Gloria, the department's new synthetic cadaver.

Human Anatomy was developed as an upper-division course that fulfills the increasingly common requirement of professional school programs for students to successfully complete a human anatomy course prior to enrollment. The course satisfies the upper-division credit requirements students need, decreases costs, and expedites graduation times.

The availability of SynDaver as well as cadaver prosections and 3D visualization software provide students with the opportunity to study human anatomy as part of their biology degree program.

Monica Stacy, a senior from Memphis, with a double major in biology and Spanish, will enter the Doctor of Physical Therapy program at the University of Tennessee Health Sciences Center after her May 2020 graduation.



“As a student beginning a physical therapy doctoral program in the fall, taking an upper-level anatomy course was a necessary prerequisite and something I believe will prepare me for my field of study. I was not disappointed.

One of the main assets of this course is the laboratory component, in which students have access to three main groups of resources to explore each lab session: the SynDaver, the plastinated cadaver prosections, and the 3D anatomy software. The variety of resources allows students an experience in

human anatomy unmatched by many schools. The variety of resources allowed me to gain a deeper understanding of each body system by analyzing individual parts of the body many times, and in different ways and contexts. The specimens I studied the most were the plastinates, in part because of the fascinating level of detail visible in each, and because you look at anatomical structures from a new perspective. Many times I thought I knew where a certain anatomical structure was located on the SynDaver, but upon investigation of the plastinated sections, I found that my mental 3D image of the structure was skewed. Being able to find the same structure repeatedly throughout the lab is an invaluable resource to understand the structure of the human body.



This course prepared me for graduate school because, frankly, anatomy is hard. The human body is incredibly complex, and to expect to learn every minute detail of every system in perfect detail in a single semester is unrealistic. I now have an incredible base of anatomical knowledge, thanks to this course. It tested me as a student in the best way possible and has prepared me for what I should expect when I enter gross anatomy lab as a first-year physical therapy student!”

Grant Wichman, a 2019 graduate, will enter the University of Mississippi Medical Center School of Medicine in August. He currently works as a research associate with Dr. Wayne Gray on vaccine development.



“Having been raised in Hattiesburg, I often hear, ‘why Ole Miss, and not USM?’ My love for the Ole Miss campus, coupled with my lifelong goal of becoming a physician, pointed me to Oxford.

Our biology program does a great job of exposing students to several of the various biological studies, ranging from ecology and virology, to marine biology or evolution. My personal favorites are those relating to human anatomy and physiology, both healthily and pathologically speaking.

As one of the first students to take Bisc 310, the new Human

Anatomy class, I knew it would be challenging, but I also knew that if I were to attend medical school, having anatomical foundation would be worth it.

I had taken Bisc 330 (Introductory Physiology) with Professor Carol Britson the previous year, and I really enjoyed her teaching style. Pre-reading and assignments outside of class prepared me for tests and allowed for better retention throughout the semester. Dr. Britson did a phenomenal job teaching us how to learn and how to study on top of the material given in class. I figured Anatomy would be similar and decided to take it.

Regarding the lab, I feel a lot more confident at tackling

lengthy and complex lab practicals that are soon to come my way. Though I appreciated the privilege of having Gloria, our SynDaver, my favorite specimens were the plastinated cross sections. There

is something oddly satisfying about learning and being able to successfully identify bones, organs, or muscles viewed from their most abnormal perspectives. Having Gloria as a full-size specimen paired with enlarged, transected, or digital specimen allows for a holistic way to learn about each organ/system at different structural levels.

Though I will have a year or so between Bisc 310 and when I will take Gross Anatomy, I know that if I can retain even a little of what I learned in 310 (materially and strategically), I’ll be prepared for success in medical school.”

UM Biology hosts ASM meeting

The Department of Biology hosted the annual meeting of the South Central Branch of the American Society for Microbiology on November 1 and 2, 2019. More than 180 microbiology faculty, students, and exhibitors from Mississippi, Louisiana, and Arkansas attended the event featuring 114 oral and poster scientific presentations, a keynote speaker, an educational session, and a reception. Two UM graduate students, Eric Weingarten and Maya Kaup, won first place awards in the student competition. Alumnus Dr. Jonas King, now at Mississippi State University, won the outstanding Assistant Professor in the South Central Branch Award.



ARISE@UM

Launched in the summer of 2015 by Professor Erik Hom, ARISE@UM is the first unified umbrella program to offer Mississippi high school students the opportunity to pursue faculty-mentored research experiences in STEM departments across campus.

Through grassroots fundraising efforts, participation in the ARISE program is cost-free. Most students participate for four weeks, although it is not uncommon for some to participate for eight weeks, during which time they are provided room and board on campus. Beyond daily laboratory experience, programs are offered about STEM careers, academic success, and scientific writing and communication of results and knowledge.

It has become increasingly clear that “doing science” is the only way to acquire experiential knowledge and a deeper appreciation and genuine understanding of how scientific principles are and can be applied. Accumulating evidence shows that research experiences are vital for STEM success, which is in turn critical for the well-being of our state and country. ARISE aims to better serve, recruit, engage, and equip the next generation of STEM workers in Mississippi, and to nurture a literate citizenry with habits of lifelong-learning, particularly those from economic-disadvantaged backgrounds.



Patrick Curtis' lab is among the pioneers of a genomic research technique called TnSeq.

Associate Professor Patrick Curtis

➤ Professor Patrick Curtis has received an International Space Station Flight Opportunity Award to send bacteria grown in his laboratory to the space station in the coming years.

The purpose of the project, titled *“Assessment of Whole Genome Fitness of Bacteria under Microgravity,”* is to better understand how bacteria respond in very weak gravity, which could possibly lead to better bacterial control mechanisms in space. These mechanisms could prove invaluable to maintaining both human and machine health aboard long-term spaceflights.

“It’s pretty common knowledge that living organisms change in response to microgravity and spaceflight, such as humans losing bone density, but hardly anyone has looked to what happens to bacteria under those same conditions,” said Curtis, who joined the department in 2012. “While one could think bacteria wouldn’t care about gravity, being so

small, the handful of studies performed show that bacteria do respond to spaceflight. This can be a big deal, since bacteria live everywhere and can have a tremendous impact on our lives, either by affecting human health or the functioning of equipment.”

Bacterial biofilms clogged the water system aboard the former Russian space station Mir, Curtis said, so understanding how bacteria react to spaceflight is important for further space exploration. “The problem with previous studies is that they mostly focused on one or two specific aspects of bacterial life. My laboratory is among the pioneers of a technique called TnSeq, which uses random mutagenesis and high-throughput sequencing to assess the usefulness of every gene in a bacterial genome under a given condition.”

Curtis’ research group will employ this technique to explore factors that influence bacteria when living aboard a spacecraft. 